3.1: Basic Rules of Differentiation

Rule 1: Derivative of a Constant

$$\frac{d}{dx}[c] = 0$$

Rule 2: The Power Rule

If n is any real number, then

$$\frac{d}{dx}[x^n] = nx^{n-1}$$

Example. Find the derivative of the following functions

$f(x) = x$

$g(x) = x^8$

$h(x) = x^{\frac{5}{2}}$

$j(x) = \sqrt{x}$

$k(x) = \dfrac{1}{\sqrt[3]{x}}$

$\ell(x) = \pi^4$

Rule 3: Derivative of a Constant Multiple of a Function

$$\frac{d}{dx}[cf(x)] = c\frac{d}{dx}[f(x)]$$

Rule 4: The Sum Rule

$$\frac{d}{dx}[f(x) \pm g(x)] = \frac{d}{dx}[f(x)] \pm \frac{d}{dx}[g(x)]$$

Example. Find the derivative of the following functions

$f(x) = 5x^3$ $\qquad$ $g(x) = \dfrac{3}{\sqrt{x}}$

$h(x) = 4x^5 + 3x^4 - 8x^2 + x + 3$ $\qquad$ $j(t) = \dfrac{t^2}{5} + \dfrac{5}{t^2} + \pi$

Example. Find the line tangent to the curve

$$f(x) = 2x + \frac{1}{\sqrt{x}}$$

at the point $(1, 3)$ Graph

Example. An experimental rocket lifts off vertically. Its altitude (in feet) t seconds into flight is given by

$$s = f(t) = -t^3 + 96t^2 + 5, \qquad (t \geq 0)$$

Find an expression v for the rocket's velocity at any time t.

Compute the rocket's velocity when $t = 0, 30, 50, 64$, and 70. Interpret your results.

Using the results from above and the observation that at the highest point in its trajectory the rocket's velocity is zero, find the maximum altitude attained by the rocket.